EXECUTIVE SUMMARY

This report was developed by KPMG LLP (KPMG), under contract to NASA and with support from an independent team of industry executives, to examine the potential for commercial utilization of the U.S. portion of the International Space Station (ISS). KPMG was tasked to provide a literature review of existing market research on ISS commercial utilization, and to identify a set of non-exclusive "Pathfinder" projects which could act as enablers to accelerate the process of commercializing the ISS. The Commercial Space Act legislation, which formed the basis for our effort, originally had requested that a market study be conducted. During the planning process for this study however, it became clear that the future commercial markets for the ISS are still too premature and any market study would be wholly speculative. In the larger sense, markets for the ISS must be nurtured, rather than studied.

The lifecycle costs for the ISS have been estimated at over $94 billion[1], and the annual operating and utilization costs are currently projected to be in the neighborhood of $1.3 billion. It should be noted that the ISS lifecycle cost estimates include funding requirements for the design, launch, assembly and 10-years of operational support. These estimates cover a period from 1985 until 2012. The station-related transportation component of the lifecycle cost has been estimated at $52.3 billion. NASA's current estimate for ISS development is between $24 and $26 billion. NASA has expressed a willingness to use alternate private transportation providers where safe and cost effective, if and when they emerge. NASA's allocation of 30% of ISS resources for commercial users is understandable, given the agency's long-standing position that there is utility in space-based R&D.

NASA has defined the meaning of its 30% allocation of ISS resources for commercial use in the following way:

> "The NASA Space Station Utilization Board has formally established a policy to allocate 30% of the US share of internal pressurized user accommodations and 25% of the external attached user accommodations on the ISS to commercial development. NASA has expressed a willingness to expand this allocation as commercial demand increases, provided that such demand does not require NASA subsidization. User "accommodations" are defined in the international MOUs as the International Standard Payload Rack (ISPR) sites, located inside the pressurized laboratories, and the attached payload accommodation sites located outside on the ISS transverse boom, as well as attached user sites located on the Japanese Experiment Module (JEM) Exposed Facility (EF).
>
> In total, at assembly complete, this currently represents:
> (27 ISPR sites) x (.30 allocation) = 8 internal commercial sites

[1] Space Station: Estimated Total U.S. Funding Requirements (Letter Report, 06/12/95, GAO/NSIAD-95-163)

(29 attached sites) x (.25 allocation) = 7 external commercial sites

These sites will include the commensurate resources necessary to undertake productive payload operations. The international MOUs define user "resources" as power, crewtime, transportation and communications capacity. These resources are also allocated at similar levels; however, payload planning will allow specific users to operate above or below the allocated levels on a scheduled basis. In other words, the resource allocations are very flexible.

As the commercial development program matures, NASA is prepared to increase commercial allocations in response to increases in the ratio of private to public investment. NASA's criteria are clear – commercial enterprises which demonstrate the highest private investment levels and involve products or services offered to non-government markets will advance most quickly in the queue.

Criteria related to safety will always remain paramount."

This level of commercial participation in the ISS would allow NASA to meet the Congressional mandates for commercialization while simultaneously freeing up funds for other critical NASA missions.

Methodology

In conducting our literature review, we used the market segments as defined in the 1994 Commercial Space Transportation Study (CSTS) Report. We included an overview of the top-level ISS-related literature that was published from 1994 to 1999. These market segments included a number of promising commercial opportunities in space unrelated to the ISS that we removed from consideration. The remaining market segments were then examined through currently available literature. These literature reviews are contained in Appendices A and B of this report. The data collection methodology employed by KPMG is provided in Appendix C.

Commercial Space Ventures Advisory Team

KPMG convened the Commercial Space Ventures Advisory Team (CSVAT). This team is comprised of a distinguished panel of experts representing a broad spectrum of expertise: from aerospace executives and financiers to entrepreneurs and state government representatives. The CSVAT met with KPMG three times during the course of this study and provided us with ongoing critical review and feedback on our findings. During these meetings, a better understanding of the larger ISS commercialization issues was developed. Details on the composition of the CSVAT are included in Appendix F of this report.

The Market

To most effectively evaluate the level of commercial interest in the ISS, we first had to develop an

understanding of what the term "commercialization" means and where it fits into the spectrum of possible approaches to ISS utilization. This term has been used as a catchall phrase by both NASA and industry to encompass a number of disparate areas of commercial activity: operation of the ISS by commercial entities; utilization of the ISS by commercial users; and augmentation of the ISS by commercial entities.

Based upon our findings and analysis of the market segments reviewed, it appears that in the near term, the most probable avenues for significant commercialization will not be tied to the research and development capabilities of the ISS. Rather, early commercial participation in the ISS will likely be from non-traditional areas such as entertainment, education and advertising. While this does not in effect utilize the ISS for its core science and technology mission, it will have two positive effects: early commercial revenue generation - which can offset the cost of long-term R&D expenditures through application of this revenue to further commercial development - and increased overall awareness of the ISS program worldwide.

As the perceived value of ISS resources and capabilities increases over time, the magnitude of commercial activity may exceed NASA's current planned 30% allocation of resources. In addition, the eventual price paid by industry to use the ISS may exceed the marginal cost incurred for that use. This could provide a significant commercial contribution towards the annual operating costs of the ISS or for reinvestment in economic development.

Impediments to Commercialization

For almost two decades, NASA has promoted both the Space Shuttle and the ISS as valuable platforms for conducting unique space-based Research and Development (R&D) that would have significant value for US industry and the taxpayers. However, in that time, the level of commercial interest in conducting these missions has been limited at best. The weak interest is understandable, given the barriers to and immaturity of commercial space development that have existed and continue today.

KPMG found, in the course of our research, that a significant number of such impediments must be addressed and resolved by NASA, industry and government if the ISS is to be successfully "commercialized". The most critical impediments we identified can be summarized by the following:

- Uncertainty and magnitude of total price (i.e., transportation, integration, and operations) makes return on investment (ROI) impossible to calculate for potential commercial users;
- The lack of awareness in the non-aerospace community regarding the defining characteristics of the ISS (capabilities, range of potential uses and value) among potential commercial participants

inhibits serious market demand for those characteristics;

- The restrictions in existing law, regulations, and policy which limit commercial payloads on Shuttle limits prospective interest in ISS commercial use;
- The burden of complex rules and procedures associated with accessing the ISS via piloted or non-piloted launch vehicles have deterred potential commercial users because of unacceptable cost and schedule penalties;
- Lack of guaranteed Space Shuttle access on a regular basis to commercial users due to lack of availability of the Space Shuttle on a predictable schedule deters potential industry users that require multiple flights of experiments within a defined time period.

Recommended Actions

KPMG and the CSVAT believe that fundamental changes must be undertaken to mitigate the issues and impediments raised above. These changes encompass the financial, policy, regulatory, technical, and market realms. The most important of these are the following:

- Create a market-oriented price mechanism for commercial usage of ISS resources;
- In concert with commercial users, streamline all procedural elements for using the Space Shuttle and the ISS, without sacrificing acceptable safety considerations;
- Create a proactive culture towards commercial and government collaboration with respect to ISS and Shuttle commercial activity;
- Create an aggressive outreach program to attract private industry users for the unique resources and capabilities of the ISS.

The Independent Asset Manager

It would arguably be more effective to have an independent organization serve as the asset manager and single interface point for all commercial users of the ISS to maximize near-term commercial participation. The entity should be created or selected from the private sector to fulfill this mission. This entity must have the authority to act independently within predefined limits, in conducting the business of the ISS (e.g. allocation of ISS resources, pricing of ISS services, etc.). This organization should be incentivized to ensure a consistently proactive stance towards commercial utilization of the ISS and allow for the growth of a competitive commercial environment in Low Earth Orbit (LEO).
As an example, over time it may be possible for the asset manager to create a revolving fund for ISS maintenance, upgrades, and economic development through a percentage allocation of commercial revenues.

Pathfinders

In collaboration with the CSVAT, KPMG has identified five Pathfinder projects representative of what might be undertaken by industry participants in collaboration with or supported by NASA and Congress. The CSVAT was composed of many direct competitors in the industry, and, as such, we believe it created an atmosphere that was inherently unbiased in selecting the Pathfinders. These projects were selected based in large part upon their potential to increase commercial utilization of the ISS in the next five years. Summaries of the Pathfinder projects are provided in Appendix D.

Conclusion

KPMG and the CSVAT believe that the findings, mitigations, and conclusions provided in this report must be incorporated into policy, as they are fundamental to promoting successful commercialization of the ISS. Government agencies have not been overly effective in the direct development of new commercial markets, nor need they be. However, building commercial markets for the ISS has been identified as an important goal. Hence, the need for an independent organization to facilitate the commercialization effort. While the Pathfinders recommended may help to move the process forward, it must be noted that significant barriers to commercialization of the ISS will remain and must be resolved. Industry, academia and government must continue to work together to reduce these barriers. In doing so, the ISS may be positioned as a significant enabler for the growth of commercial space activities. It should be noted that NASA has taken a proactive approach to the ISS commercialization issue by publishing a Commercial Development Plan in November of 1998.